FRESHWATER CENTRE

BONUS
SCIENCE FOR A BETTER FUTURE OF THE BALTIC SEA REGION

BONUS Sunken Wreck Environmental Risk Assessment - Combined Modern Risk Tool with Oil Removal Assessment

WRECKS OF THE WORLD III: Shipwreck Risk Assessment
October 12-13 2015, Gothenburg, Sweden

Jorma Rytkönen, Finnish Environment Institute

www.syke.fi/projects/swera

SYKE

AVANCEZ 1829

ALFONS HÅKANS
POLLUTION RECOVERY

MSI

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- Definition of Wreck
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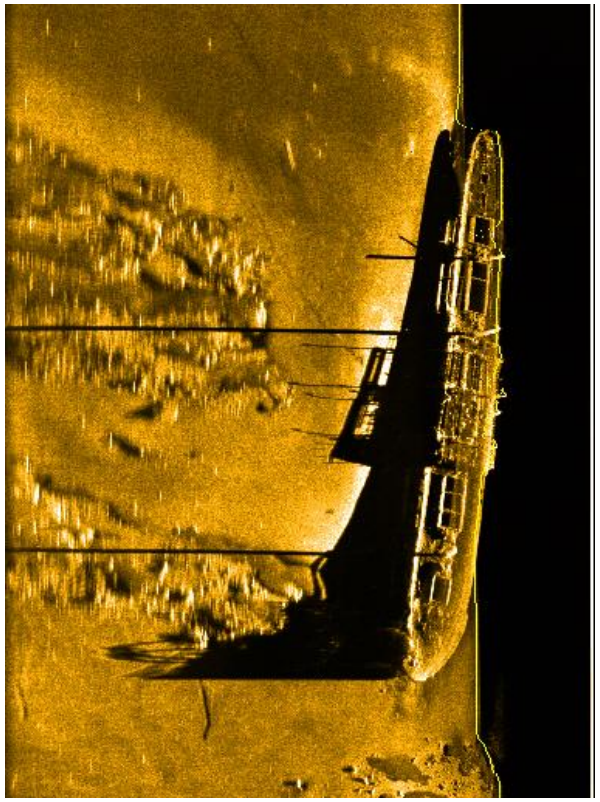

Side scan sonar view over a sunken cargo ship (Finnish Border Guard)

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Definition of ”WRECK”

Courtesy: Badevanne – German destroyer ”Z36”

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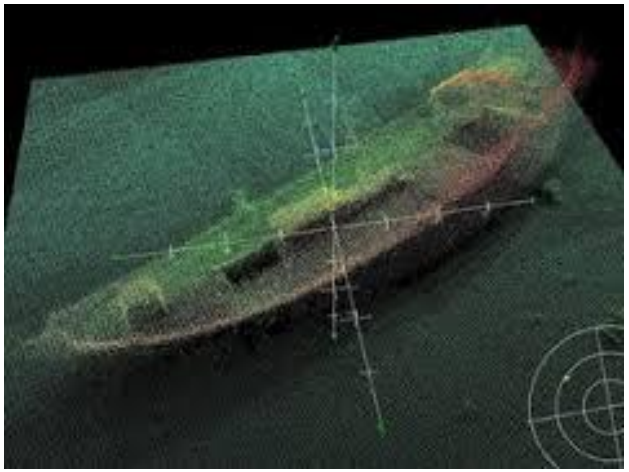
Wrecks – risk for oil pollution ?



Courtesy: WWF

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More than 8500 potentially polluting wrecks worldwide.

Potentially Polluting Wrecks in Marine Waters, J.Michel, D.S.Etkin, 2005

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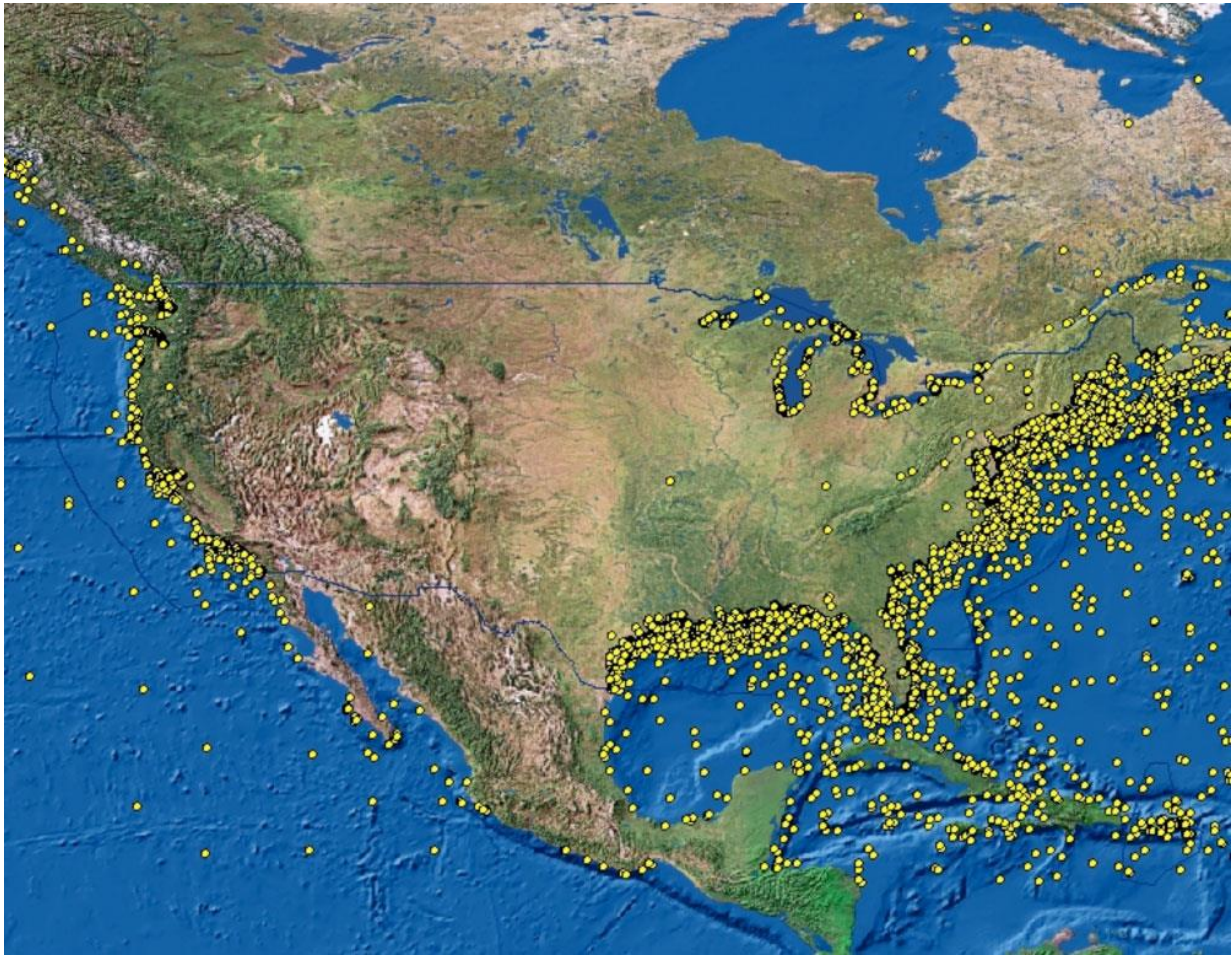
USA

The NOAA Resources and Under Sea Threats (RUST) database has over 30,000 targets, including 20,000 vessels.

573 with oil pollution risk

U.S. Coast Guard 2013:

* **Low Priority 11-45 wrecks**
* **Medium Priority 36-40 wrecks**
* **High Risk 6-36 wrecks**



Source: NOAA 2013. Risk Assessment for Potentially Polluting Wrecks in U.S. Waters

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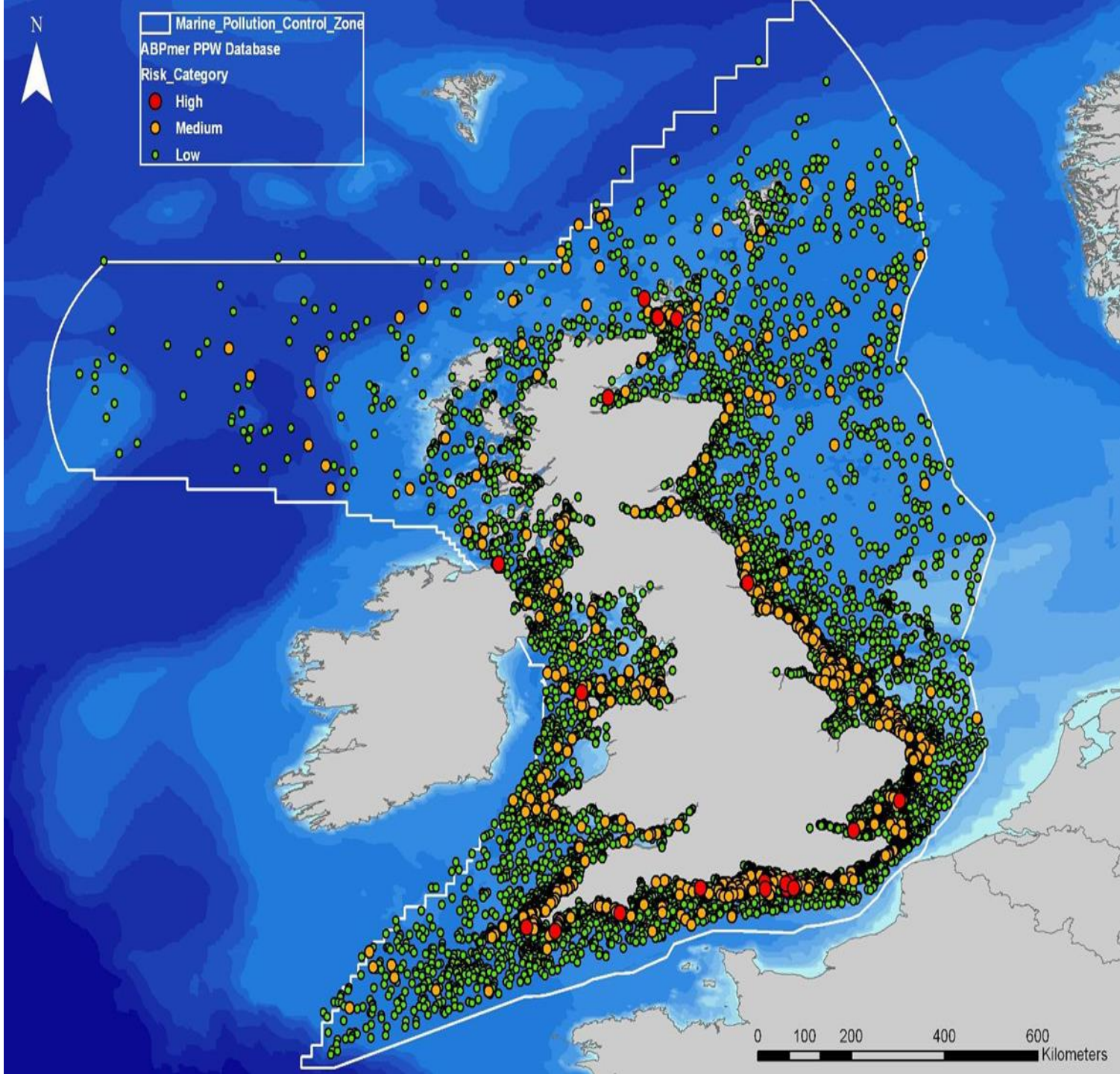
UK



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NORWAY

- **Low Risk wrecks 1700**
- **Moderate Risk 350 wrecks 350**
- **High Risk wrecks 30**

Inventory of more than 2000 wrecks registered in the 1990s ("Wreck Program")

- 30 shipwrecks prioritized
  - 9 wrecks empty
  - 3 wrecks not found
  - 18 wrecks assumed to contain from 10 to 300 tons of oil
- Wrecks drained
  - 1994
    - Blücher (Ger)
  - 2007-2008
    - Velheim (Ger)
    - Nordvard (Ger)
  - 2011-2013
    - HMS Bittern (UK)
    - RFA Boardale (UK)
    - Erich Giese (Ger)
    - Neuenfels (Ger)
    - U-864 (Ger)

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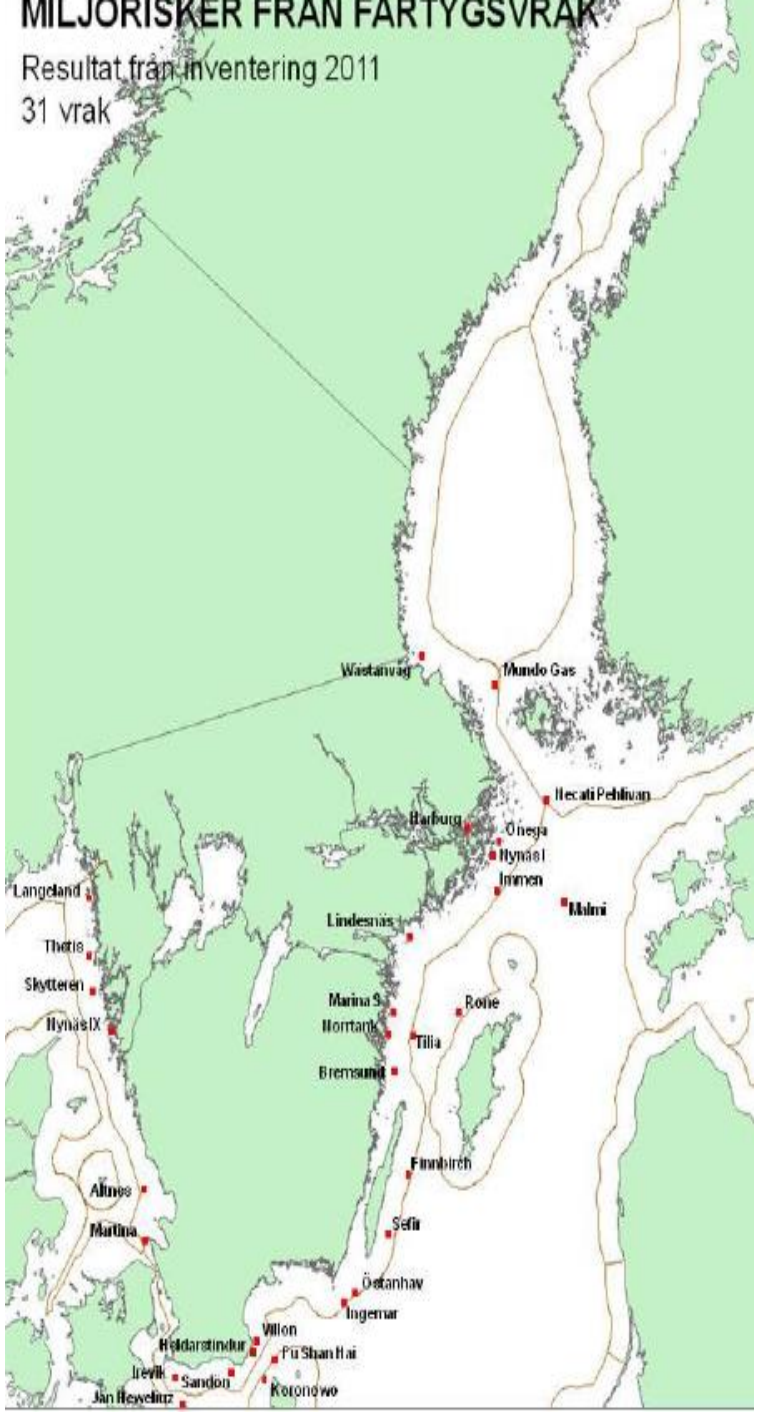
Sweden

- **2700 subsea objects**
- **Moderate Risk 316 wrecks**
- **High Risk 31 wrecks**



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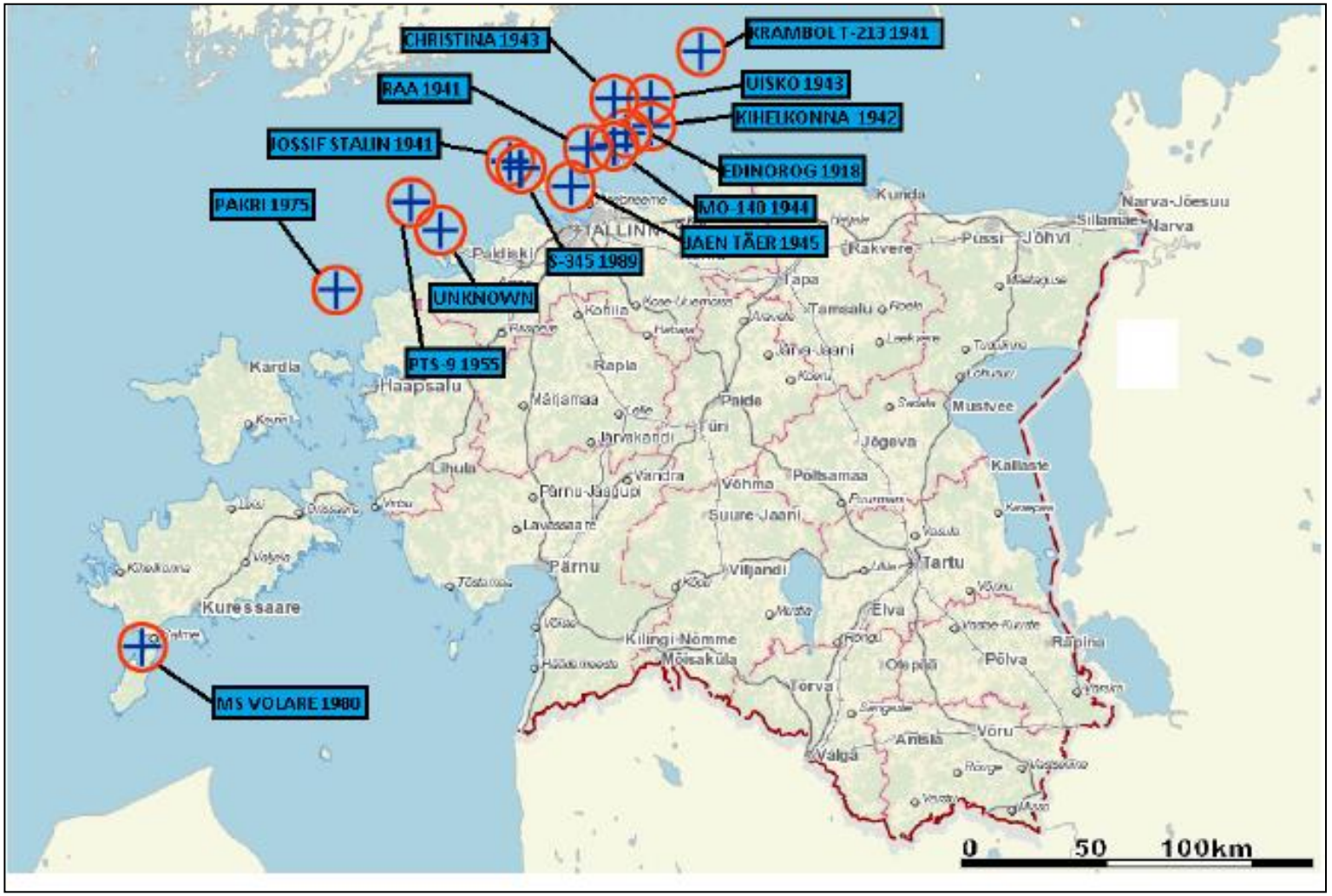
Estonian wreck register

705 wrecks, from which 84 found & confirmed
14 wrecks with potential oil risk !



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FINLAND, VTT 1999

Wreck Class	Description	pcs.	Percentage of surely identified wrecks
I	Wreck contains, with relatively high probability, over 100 tonnes of oil or it is in some other respect similarly dangerous to the environment.	22	32 % / 68 %
II	Wreck may contain over 100 tonnes of oil because of the size, type or other structural feature of the vessel.	24	21 % / 79 %
III	Wreck may contain 10-100 tonnes of oil.	68	n.a
0	Wreck contains less than 10 tonnes of oil.	306	n.a

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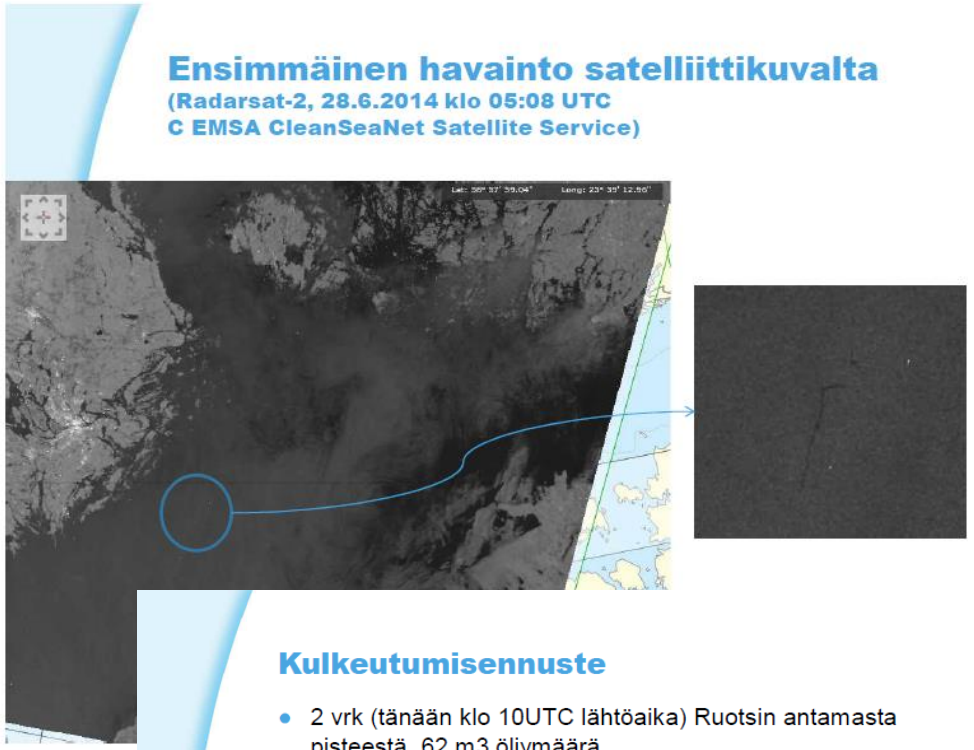
Wreck alert cases in Summer ?

- 30.6. case in Sweden
- In August expected wreck case in Finnish Archipelago – the detected oil spill was probably due to the lubrication oil leakage through propeller shaft's sealing – wreck "Brita Dan"was checked.



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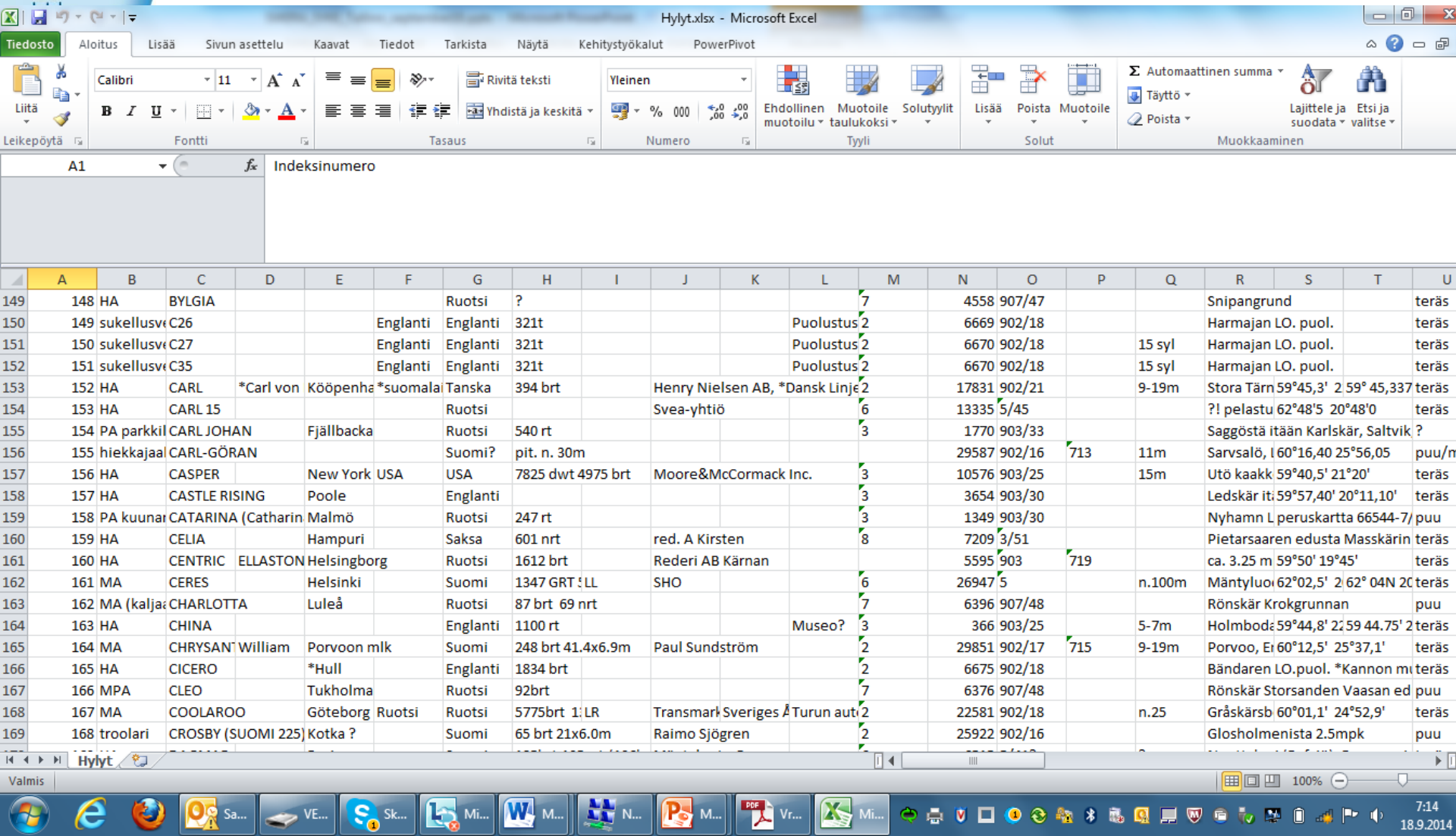
Wreck Classification – Finnish Contribution

- Old wreck register made already in 1990…1999
- Register contains more than 1 100 objects
- Wrecks have been categorized based on the expected amount of oil onboard
- Priority has been on the expected amount fo oil onboard
- Sensitive areas and/or water depth on site have been ”ignored”
- Potential for salvage operations ”ignored”
- Novel idea under swera is to select ”hot spots, based on different categorization (VRAKA?)
- Selected objects will be put to the BORIS-2 data base
- Helcom has its own Map and Data service



	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U
149	148	HA	BYLGIA				Ruotsi	?					7	4558	907/47			Snipangrund			teräs
150	149	sukellusv	C26			Englanti	Englanti	321t				Puolustus	2	6669	902/18			Harmajan LO. puol.			teräs
151	150	sukellusv	C27			Englanti	Englanti	321t				Puolustus	2	6670	902/18		15 syl	Harmajan LO. puol.			teräs
152	151	sukellusv	C35			Englanti	Englanti	321t				Puolustus	2	6670	902/18		15 syl	Harmajan LO. puol.			teräs
153	152	HA	CARL	*Carl von	Kööpenha	*suomalai	Tanska	394 brt		Henry Nielsen AB,	*Dansk Linje		2	17831	902/21		9-19m	Stora Tärn	59°45,3' 2	59° 45,337	teräs
154	153	HA	CARL 15				Ruotsi			Svea-yhtiö			6	13335	5/45			?! pelastu	62°48'5	20°48'0	teräs
155	154	PA parkki	CARL JOHAN		Fjällbacka		Ruotsi	540 rt					3	1770	903/33			Saggöstä itään Karlskär, Saltvik		?	
156	155	hiekkajaa	CARL-GÖRAN				Suomi?	pit. n. 30m						29587	902/16	713	11m	Sarvsalö,	60°16,40	25°56,05	puu/m
157	156	HA	CASPER		New York	USA	USA	7825 dwt 4975 brt		Moore&McCormack Inc.			3	10576	903/25		15m	Utö kaakk	59°40,5'	21°20'	teräs
158	157	HA	CASTLE RISING		Poole		Englanti						3	3654	903/30			Ledskär it	59°57,40'	20°11,10'	teräs
159	158	PA kuunar	CATARINA (Catharin		Malmö		Ruotsi	247 rt					3	1349	903/30			Nyhamn L	peruskartta 66544-7/		puu
160	159	HA	CELIA		Hampuri		Saksa	601 nrt		red. A Kirsten			8	7209	3/51			Pietarsaaren edusta Masskärin			teräs
161	160	HA	CENTRIC	ELLASTON	Helsingborg		Ruotsi	1612 brt		Rederi AB Kärnan				5595	903	719		ca. 3.25 m	59°50'	19°45'	teräs
162	161	MA	CERES		Helsinki		Suomi	1347 GRT	LL	SHO			6	26947	5		n.100m	Mäntyluo	62°02,5' 2	62° 04N 20	teräs
163	162	MA (kalja	CHARLOTTA		Luleå		Ruotsi	87 brt 69 nrt					7	6396	907/48			Rönskär Krokgrunnan			puu
164	163	HA	CHINA				Englanti	1100 rt				Museo?	3	366	903/25		5-7m	Holmboda	59°44,8' 2	59 44.75' 2	teräs
165	164	MA	CHRYSAN	William	Porvoon mlk		Suomi	248 brt 41.4x6.9m		Paul Sundström			2	29851	902/17	715	9-19m	Porvoo, E	60°12,5'	25°37,1'	teräs
166	165	HA	CICERO		*Hull		Englanti	1834 brt					2	6675	902/18			Bändaren LO.puol. *Kannon m			teräs
167	166	MPA	CLEO		Tukholma		Ruotsi	92brt					7	6376	907/48			Rönskär Storsanden Vaasan ed			puu
168	167	MA	COOLAROO		Göteborg	Ruotsi	Ruotsi	5775brt 1	LR	Transmark	Sveriges A	Turun aut	2	22581	902/18		n.25	Gråskärsb	60°01,1'	24°52,9'	teräs
169	168	troolari	CROSBY (SUOMI 225)		Kotka ?		Suomi	65 brt 21x6.0m		Raimo Sjögren			2	25922	902/16			Glosholmenista 2.5mpk			puu

forecasts
Floods
State of the surface waters
Protection of waters and the sea
Restoration of water bodies
Use of water resources
Environmental emergency response in Finland
› Accident updates
› Marine pollution response
› SYKE's officer on duty
› Situation Awareness System (BORIS)
› Oil spill response exercises

A Common Situation Awareness System for Finnish Authorities Participating in Oil Spill Response (BORIS)

In official service since the beginning of 2013

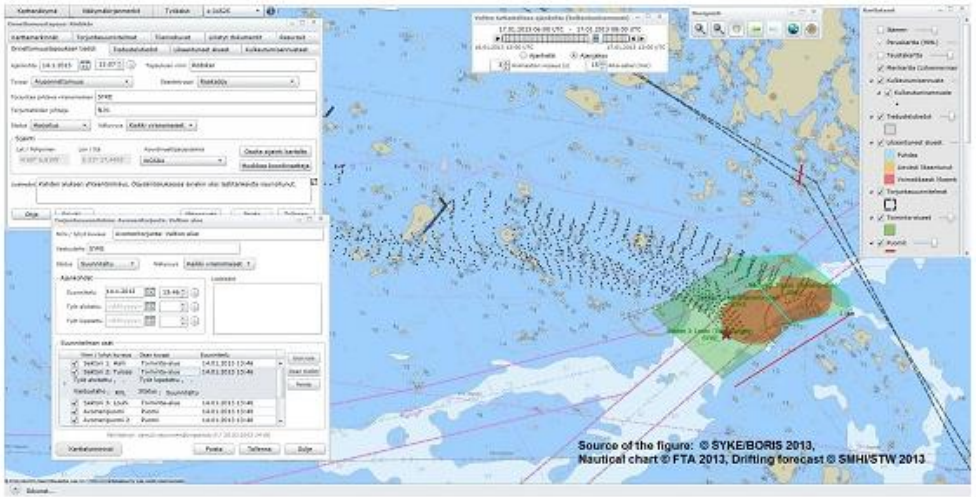


Figure 1. Using BORIS officials can access up-to-date information e.g. on the extent of oil spills, calculate future movements of the oil and plan response measures directly on a map interface. - In picture the oil spill is illustrated as an orange polygon and the future movements of the oil with black dots from the spill towards WNW. Response areas are illustrated with green polygons and protective booming with black line in front of the island.

Current Stage of the Project BORIS

The latest BORIS development project has been carried out between 2009 and 2013. As a result of the project a system called BORIS 2.0 was officially taken into service at the beginning of 2013. The

from which the information concerning a certain case can easily be retrieved at a later point in time.

Examples of BORIS views

Figure 2. BORIS start page.
Until May 2013 over 150 officials from 30 different Finnish authorities are already BORIS users

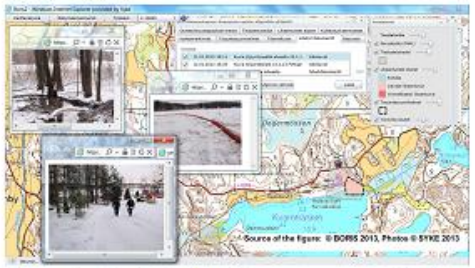


Figure 3. An inland oil spill response operation in January 2013 in Southern Finland. Oil leaked from power plant to ground and a lake. Oiled area is illustrated with pink. Source of the figure: © SYKE/BORIS 2013, Photos © SYKE 2013.

Figure 4. Reconstruction of the oil spill response operation after the grounding of m/s Hälsingland in Bay of Bothnia 1997. Observed oil spills are illustrated with red polygons and response areas with green polygons. Source of the figure: © SYKE/BORIS 2013, Nautical chart © FTA 2013, Photos © FBG 1997 and SYKE 2012.

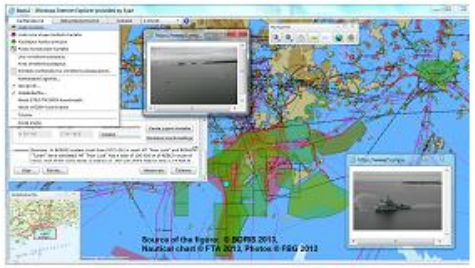


Figure 5. Oil spill scenarios (red polygons) and oil response areas (green polygons) of HELCOM fleet and Finnish Rescue Services Districts during HELCOM BALEX DELTA 2012 Exercise in Gulf of Finland. Source of the figure: © SYKE/BORIS 2013, Nautical chart © FTA 2013, Photos © FBG 2013.

HELCOM data and map service

maps.helcom.fi/website/mapservice/index.html

Baltic Sea data and

Provided by HELCOM

HELCOM data and map service

HELCOM map and data service

HELCOM data can be used freely for non-commercial purposes. Users are requested to cite HELCOM as the data source when using downloaded datasets in publications. Use conditions are data layer specific and included in the metadata file of each layer. Note that some datasets in the map and data service are hosted and owned by other organisations. In that case the data is not downloadable from this service. See service description in the layer list for more information.

500 km

300 mi

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New sources of data

- Based on surveying (Maritime administration)
- Side Sweep sonar readings of Coast Guard
- Data contains numerous underwater objects
- Part of these wrecks have been confirmed by divers & reports
- Amount of oil has not been studied at all
- Work continues…..
- Naval forces might have some confidental data
- War objects under the War Museum
- Finnish Maritime Museum has their own register (arhealogical objects)

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Liikennevirasto

Merenmittauksissa 13.7.2000 - 13.12.2012 havaitut kohteet.

16. tammikuuta 2013
15:16:45

Kohde ID	Pvm	Kohteen tunnus	Kohdeilmoituksen nimi	Lat	Lon	Kohteen koko	Kohteen syvyys	Mittaus pvm	Lisätietoja
Ruotsi - Sweden									
Kunta	-								
219	26.9.2012	VHE003		61,527695	18,423863	12 x 4 x 1.5	55.1 / 53.6	26.5.2011	
220	26.9.2012	VHE004		61,774625	18,251838	17 x 5 x 2.5	81.1 / 78.5	24.5.2011	
221	26.9.2012	VHE005		61,478630	18,480804	12 x 7 x 5	47.5 / 42.3	26.5.2011	
222	26.9.2012	VHE006		61,570111	18,997692	28 x 9 x 8	68.7 / 60.9	27.5.2011	
223	26.9.2012	VHE007		61,610608	19,042629	9 x 5 x 4	51.1 / 46.7	28.5.2011	
224	26.9.2012	VHE008		61,693102	19,112620	6 x 6 x 5	73.9 / 68.3	30.5.2011	
225	26.9.2012	VHE009		61,528780	18,950773	11 x 7 x 6	73.7 / 67.4	5.6.2011	
226	26.9.2012	VHE010		61,494780	18,987267	20 x 8 x 1	79.1 / 78	6.6.2011	
227	26.9.2012	VHE011		61,380452	18,948420	9 x 8 x 5	74.8 / 70	13.6.2011	
228	26.9.2012	VHE012		61,377620	18,947586	9 x 8 x 3	74.4 / 70.3	13.6.2011	
229	26.9.2012	VHE013		61,029790	19,256527	86 x 12 x 11	104.5 / 93.8	29.6.2011	
230	26.9.2012	VHE014		61,005457	19,266024	7 x 5 x 4	116 / 111.8	29.6.2011	
231	26.9.2012	VHE015		61,008796	19,078866	31 x 12 x 5	86.2 / 81.4	2.7.2011	
232	26.9.2012	VHE016		61,080796	18,985429	10 x 4 x 2.3	56 / 53.7	5.7.2011	
233	26.9.2012	VHE017		60,900967	19,074020	63 x 50 [illegible]	98 [illegible]1.2	14.7.2011	

SYKE

Merenkulkulaitos

Merikartoitus

KMm_Kohde_GOF7

KUVAUS MERENPOHJAN KOHTEESTA "GOF7", MEA SUUNTA, 2005

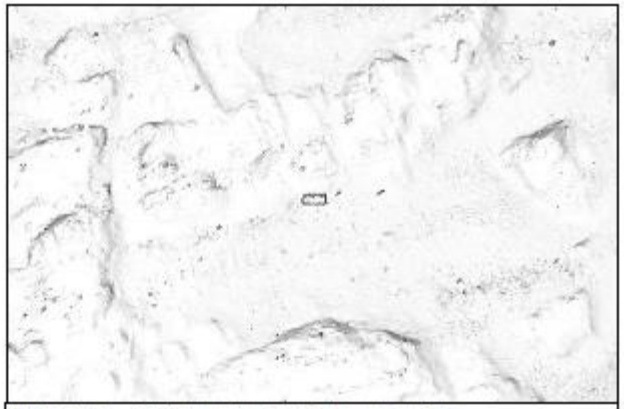
Sijainti:
KKJ:ssä

3.kaistan xy-koordinaatit	maantietoelliset koordinaatit
x = 6652097.00	lat = 59° 58.6927 '
y = 3453208.00	lon = 26° 09.7207 '

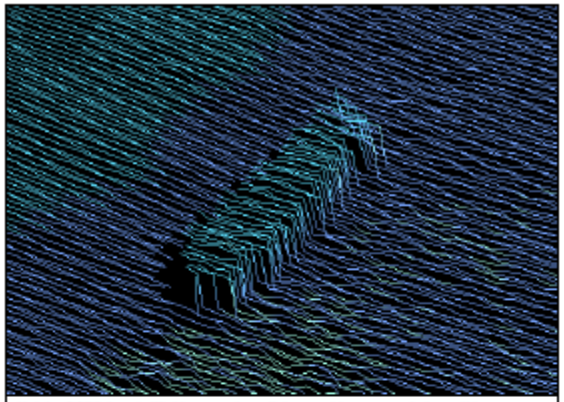
S2: **GOF057mT**

Koko ja muoto:
Kohteen pituus on n. 28 metriä ja leveys n. 8 metriä ja korkeus n. 5 metriä pohjan tasosta. Kohteen muoto ilmenee tarkemmin olevista kuvista Kohde_GOF7_kuva1 ja Kohde_GOF7_kuva2.

Alueen topografia (ja morfologia):
Kohteen sijaitsee n. 54 m:n syvyydessä, ympäristön yleissyvyyden ollessa n. 59 metriä. Kohteen ympäristön topografia on vaihtelevaa hylyn sijaitessa loivasti etelään viettävässä rinteessä. Pohjan(pinnan) laatu on pehmeähköä maa-ainesta.



Kohde_GOF7_kuva1: "Pohjanmuotokartta", jossa hylky erottuu keskellä.



Kohde_GOF7_kuva2: "Pohjanmuotokartta", jossa voidaan erottaa hylyn pelkistetty runkomuoto.

Museoviraston tietoja:

"Avomerihylky" (vedenalaislöytöjen rekisterissä kohde 2500), Porvoon edusta/talousvyöhyke.

Merenkulkulaitoksen kohde GOF7
Tyyppi: puuhylky. Ajoitus: 1800-luku. Arvio ajoituksesta on tehty tarkastussukelluksen yhteydessä aluksen rakenteen perusteella. Kohde on luokiteltu muinaisjäännökseksi.
Kaksimastoisen tasasaumaisen purjealuksen hylky, jonka pituus on noin 28 metriä ja leveys noin kahdeksan metriä. Korkeus pohjan tasosta on noin viisi metriä. Hylky makaa pystyssä kölillään, runko vaikuttaa pääosin ehjältä, vain perä on tuhoutunut. Keularanka on paikallaan, keulapuomi on poissa. Kansirakenteet ovat hajonneet ja mastot ovat kaatuneet rungon päälle.
Hylky on löytynyt Merenkulkulaitoksen tekemässä merenpohjan kartoituksessa vuonna 2005. Jussi Kaasisen sukeltajaryhmä teki kohteelle tarkistussukelluksen heinäkuussa 2007 ottaen valokuvia ja videota. Kyseessä on kaksimastoinen purjealus, joka rakenteensa perusteella voi olla 1800-luvulta peräisin oleva kauppa-alus. Alus muistuttaa ns. keulakuvahylkyä Hangon läntisellä selällä. Hylkyä ei ole identifioitu.

Merenkulkulaitos

Merikartoitus

KMm_Kohde_GOF6

KUVAUS MERENPOHJAN KOHTEESTA "GOF6", MEA SUUNTA, 2005

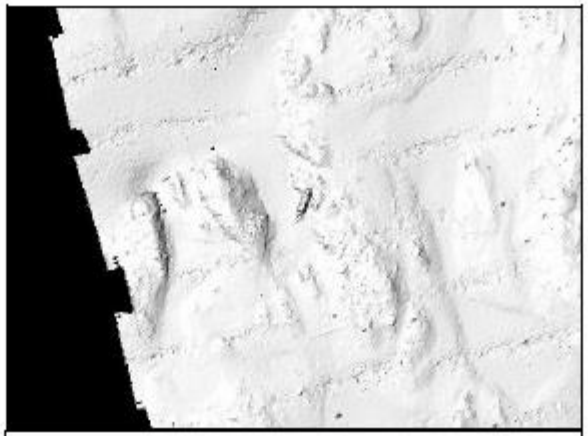
Sijainti:
KKJ:ssä

3.kaistan xy-koordinaatit	maantieteelliset koordinaatit
x = 6651480.00	lat = 59° 58.2832'
y = 3442998.00	lon = 25° 58.7618'

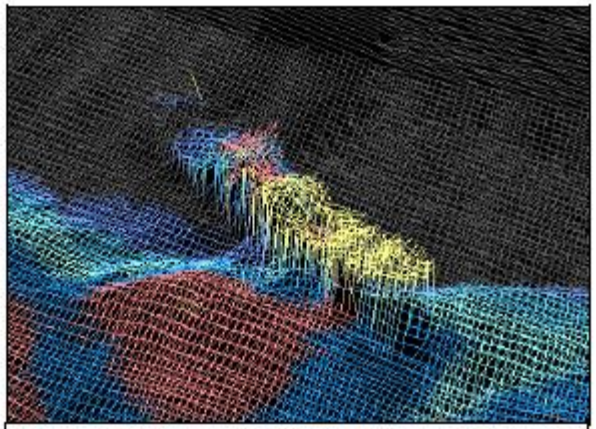
S2: **GOF057mQ**

Koko ja muoto:
Kohteen pituus on n. 67 metriä ja leveys n. 9 metriä ja korkeus n. 7-10 metriä pohjan tasosta. Kohteen muoto ilmenee tarkemmin olevista kuvista Kohde_GOF6_kuva1 ja Kohde_GOF6_kuva2.

Alueen topografia (ja morfologia):
Kohteen keulaosa sijaitsee n. 42 m:n syvyydessä, ja perätosa 61 m:n syvyydessä, ympäristön syvyyden vaihdellessa välillä 55-63 m välillä. Kohteen ympäristön topografia on vaihtelevaa hylyn sijaitessa jyrkähkössä, länteen viettävässä rinteessä.



Kohde_GOF6_kuva1: "Pohjamuotokartta", jossa hylky erottuu keskellä



Kohde_GOF6_kuva2: "Pohjamuotokartta", jossa voidaan erottaa hylyn keulaosa ja peräosa

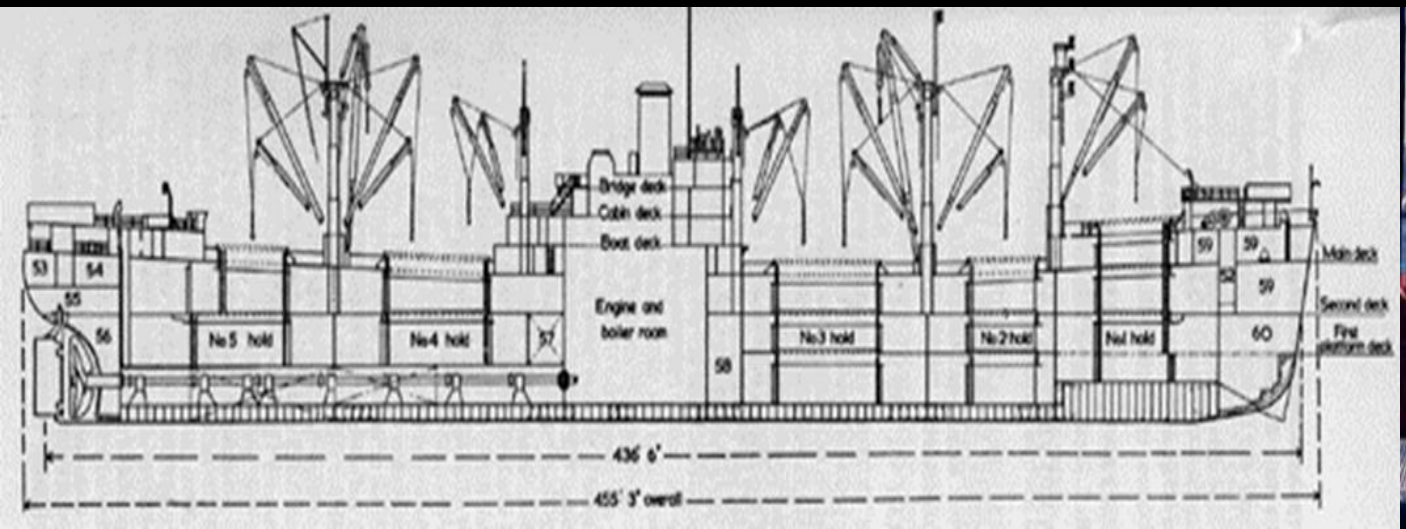
Merimuseon tietoja kohteesta:

"ss. Ulf Jarl" (vedenalaislöytöjen rekisterissä kohde 2501), Porvoon edusta/talousvyöhyke

Merenkulkulaitoksen kohde GOF6
Ajoitus: 1900-luku. Ajoituskriteeri: hylky on tunnistettu tarkastussukelluksen yhteydessä. Kohdetta ei ole luokiteltu muinaisjäännökseksi.
Rahtilaivan hylky, jonka pituus on noin 67 metriä ja leveys noin 9 metriä. Korkeus pohjan tasosta 7-10 metriä. Lastiruumassa on laatikkolastoja ja vaneria. Komentosillan oikealla puolella on telineillään laivavene. Aluksen potkuri ja peräsin ovat paikoillaan.
Hylky on löytynyt Merenkulkulaitoksen tekemässä merenpohjan kartoituksessa vuonna 2005. Jussi Kaasisen sukeltajaryhmä teki hylylle tarkistussukelluksen heinäkuussa 2007 ottaen valokuvia ja videota. Ryhmä identifioi hylyn norjalaiseksi höyrylaiva Ulf Jarliksi, joka upposi 21.9.1924 ajettuaan miinaan. Onnettomuudesta ei tullut kuolonuhreja. Aluksen lastina oli vaneria ja laatikkolastoja.

Case; SS Park Victory

Oil Recovery Operation's working hours 1994-2000;
Oil recovery vessels Halli and Hylje total 5000 h.
Finnish Navy Divers, total 1400 dives and 1200 working hours.
Observation class ROV, 1700 working hours.



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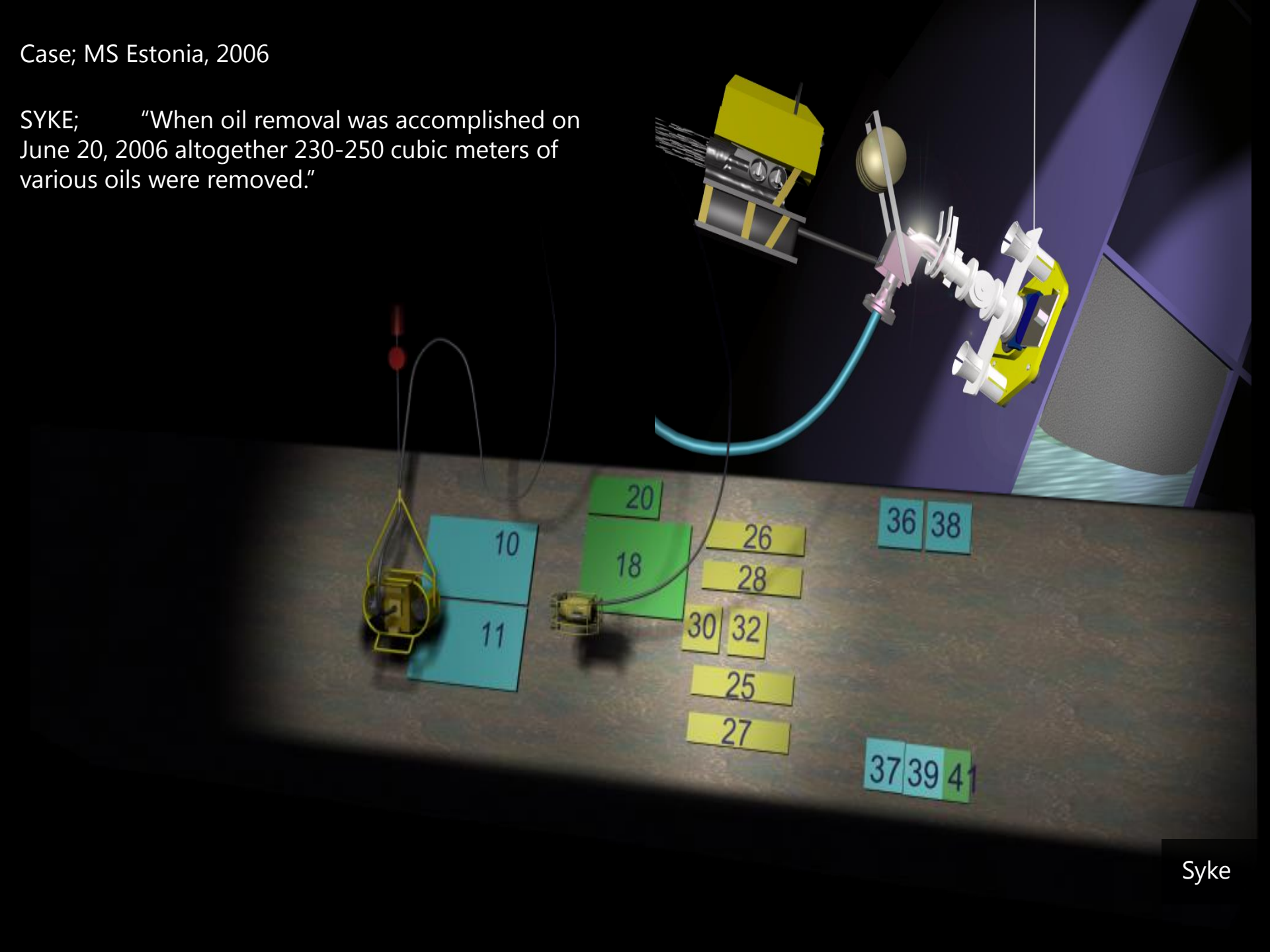
Case; MS Estonia, 2006

SYKE; "When oil removal was accomplished on June 20, 2006 altogether 230-250 cubic meters of various oils were removed."

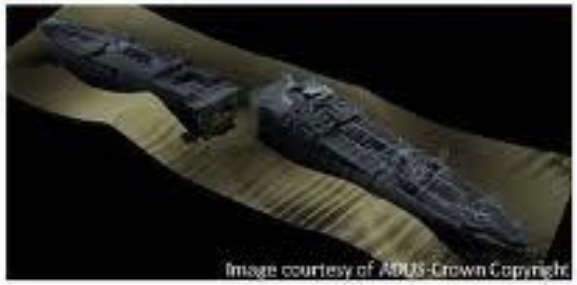


Syke

FRESHWATER CENTRE

BONUS SWERA: Main Objectives

- 1.) **Wreck survey** – selecting the primary targets (high potential for oil pollution, **New Data Base**
- 2.) **Validation of the wreck model (Vraka)**
- 3.) **Modification** of the existing wreck model to also include the risk assessment of different salvage operation alternatives
- 4.) **Developing innovative technological solutions** for oil removal operations,
- **Salvage Toolbox Development**



SYKE

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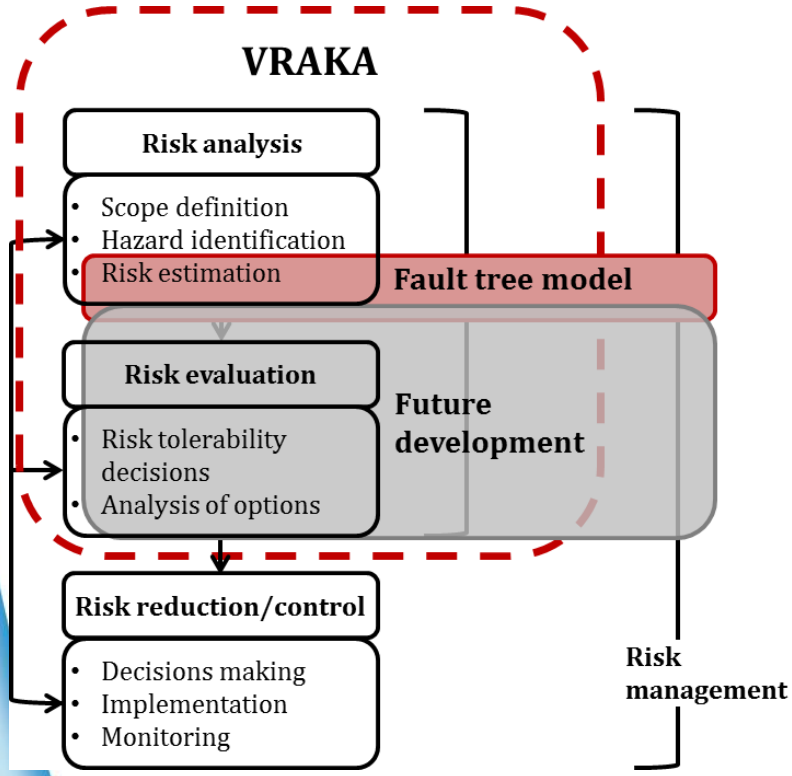
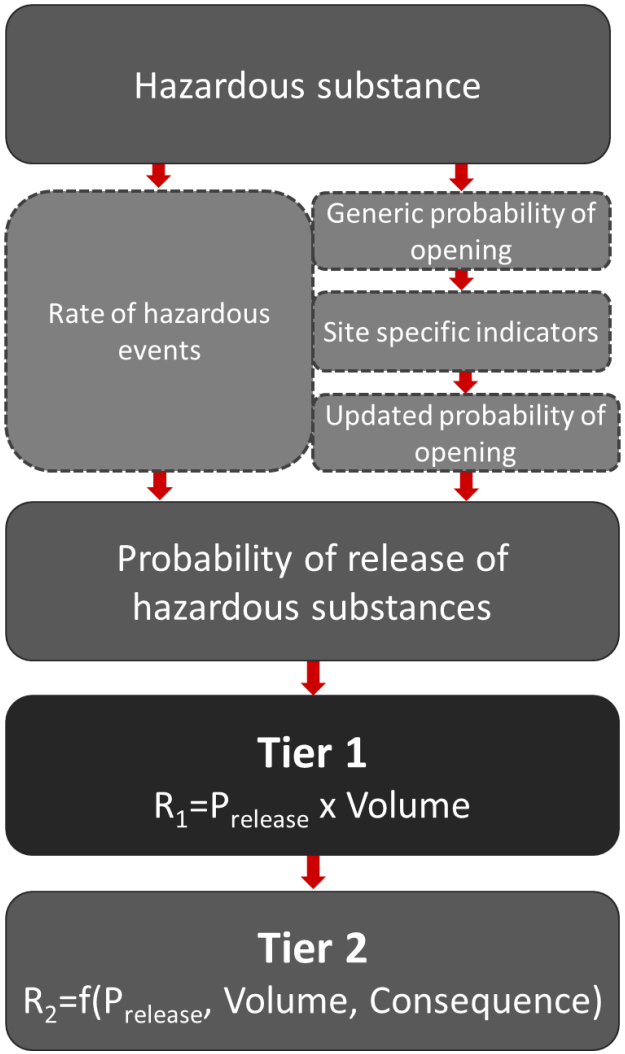
Further development of the VRAKA model

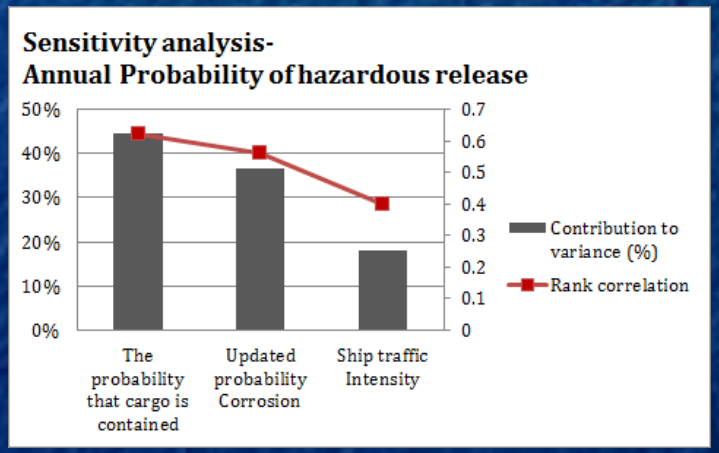




SYKE

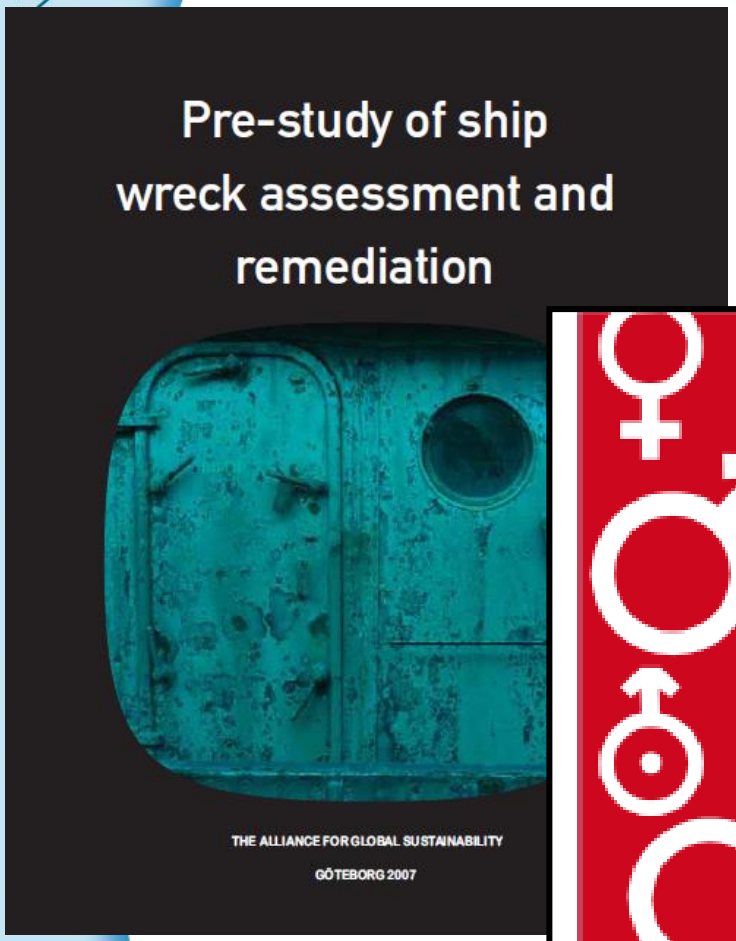
By Hanna Landquist /Chalmers University


ALFO S HÅKANS


Sensitivity analysis-
Annual Probability of hazardous release
50%
40%
30%
20%
10%
0%
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
Contribution to variance (%)
Rank correlation
The probability that cargo is contained
Updated probability Corrosion
Ship traffic Intensity


HALLI

SELECTED SWEDISH REFERENCES /CHALMERS



CENTRE

BONUS

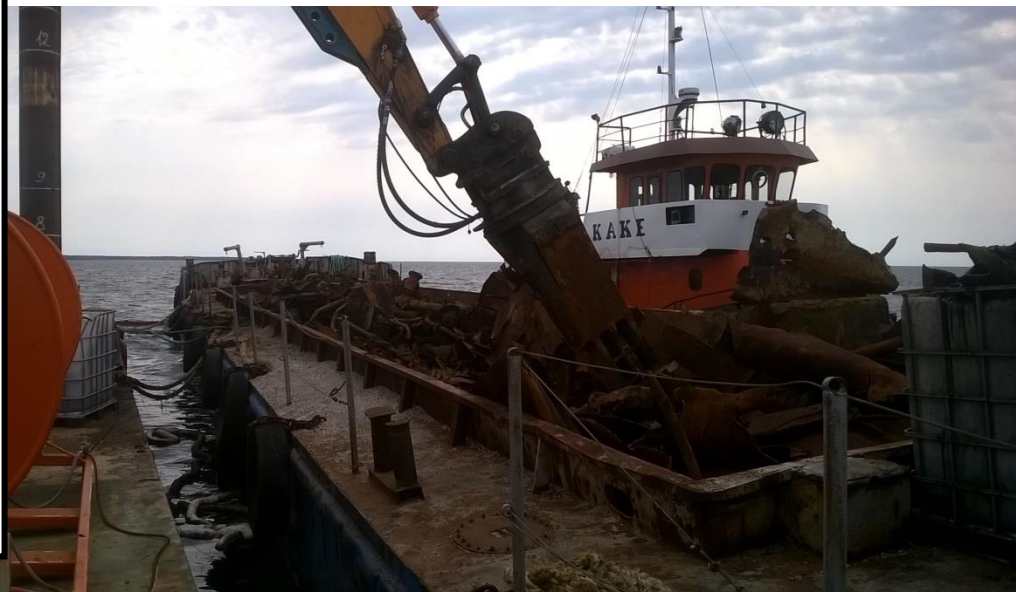
SWERA

SUNKEN WRECK ENVIRONMENTAL RISK ASSESSTMENT

Photo: Kaimo Vahter / Shipspotting.com

Deliverable 1.2

Case study of typical wreck in Estonian waters



BONUS

SWERA

SUNKEN WRECK ENVIRONMENTAL RISK ASSESSMENT

Deliverable 4.1

STATE OF THE ART OF THE TECHNOLOGIES AND CAPABILITIES

ALFONS HÅKANS
POLLUTION RECOVERY

SYKE

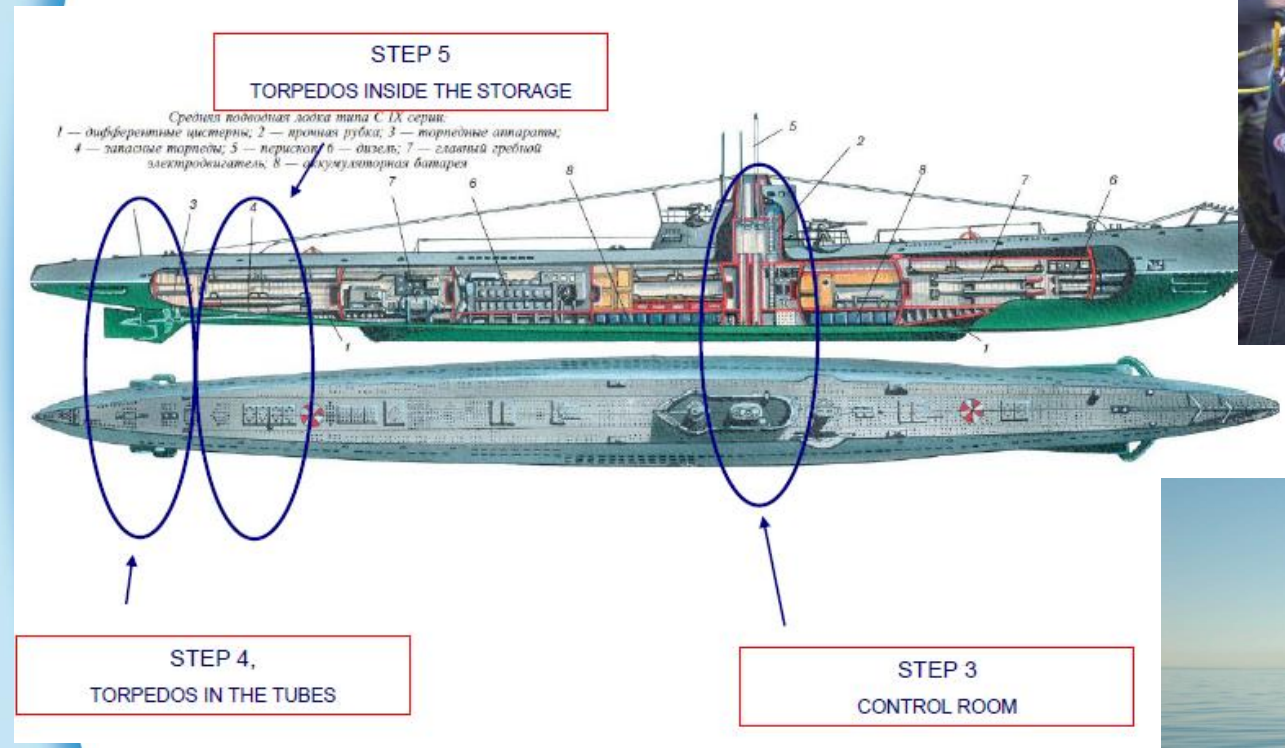
http://www.alfonshakans.fi/pollution-recovery/

HELCOM Expert Group on environmental risks of hazardous submerged objects ; Meeting Agenda - October 14-15 2015

1. Adoption of the Agenda
2. Matters arising from other HELCOM meetings
3. SUBMERGED Assessment current status
4. Draft chapter on Wrecks
5. Wrecks: Geographical distribution
6. Wrecks: Environmental issues
7. Wrecks: Risk assessment
8. Work plan and future meetings
9. Outcome of the Meeting

Jukka-Pekka Nummila, Finnish Navy

Clerance and disposal of explosives from WW II Submarine S2



FU SHAN HAI

The emptying of the FU SHAN HAI

24th of July - 12th of September 2013

THE RESULT

Dirty water recovered 620 m³

Oil recovered 251 m³ = 249 ts.

Compared to this

Missing 335 tonnes

Operation lasted 50 days

DK government pays the bill.

FRESHWATER CENTRE

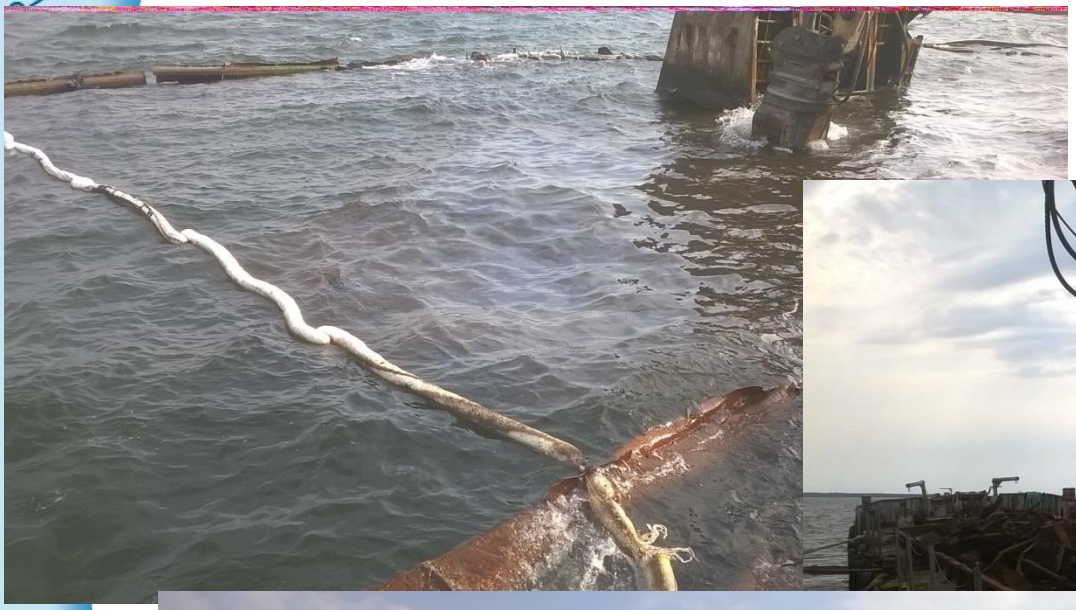
Actions carried out /response received

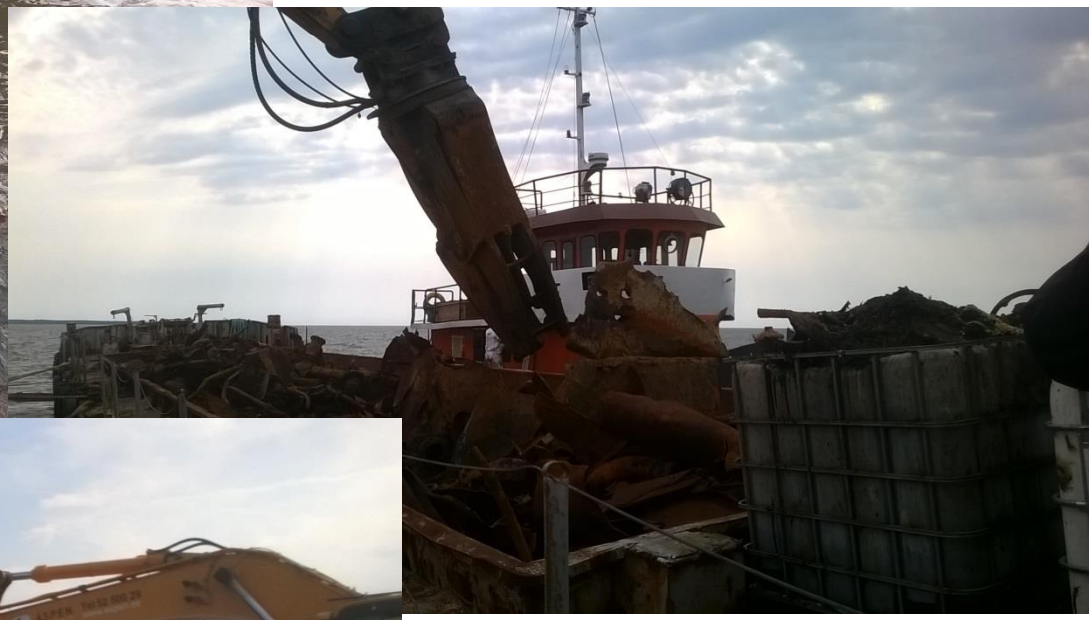
- Finland, Sweden and Estonia wreck registers and risk assessment work going on by SWERA project;
- Sweden and Finland had a joint diving exercise operation in Oxellösund Sweden in September 2014 to find out and remove dumped hazardous waste. Exercise was carried out based on the Copenhagen agreement.
- Additional project proposals have been made in Finland Estonia's (Wreck Info) by the Technical University of Tallinn and SYKE's new proposal;

Side scan sonar tool used in Oxellösund by the Finnish Frontied Guard

SYKE

MS Volare, (please see Tallinn Univ. of Technology presentation)





FRESHWATER CENTRE

Proposed New R&D Project: Oil Removal and Salvage Toolbox for Sunken Wrecks and Submerged Dangerous Goods

- The main objective of the proposed project is to demonstrate and validate new and innovative tools for oil removal from sunken wrecks having oil or packaged dangerous goods onboard.
- Second objective of this proposal is through the surveys based on preselected targets to validate modern smart sensor technologies to help the authorities and municipalities to evaluate the salvage potential of certain target with the suitable risk approach.
- Third objective is to select suitable underwater object(s) for oil removal demonstration(s). The selected underwater objects may be a sunken ship of container with dangerous goods onboard.
- Final goal is to produce a toolbox to evaluate the threat for oil pollution and to select technical proper means for salvage and oil/chemical removal operations.

SYKE

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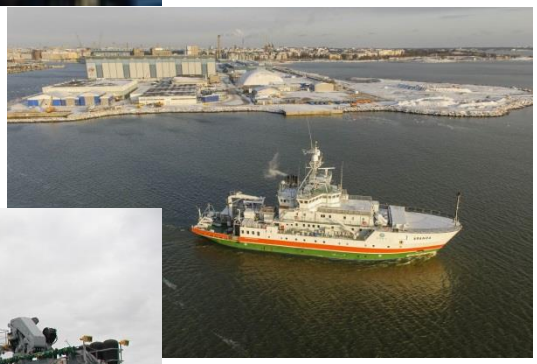
Oil Removal and Salvage Toolbox for Sunken Wrecks and Submerged Dangerous Goods

- Management
- Analyses of the salvage-oil removal operations
- Field surveys & demonstrations based on new innovative sensor techniques
- Full-scale oil removal operation
- Risk analyses and operational procedures
- Dissemination



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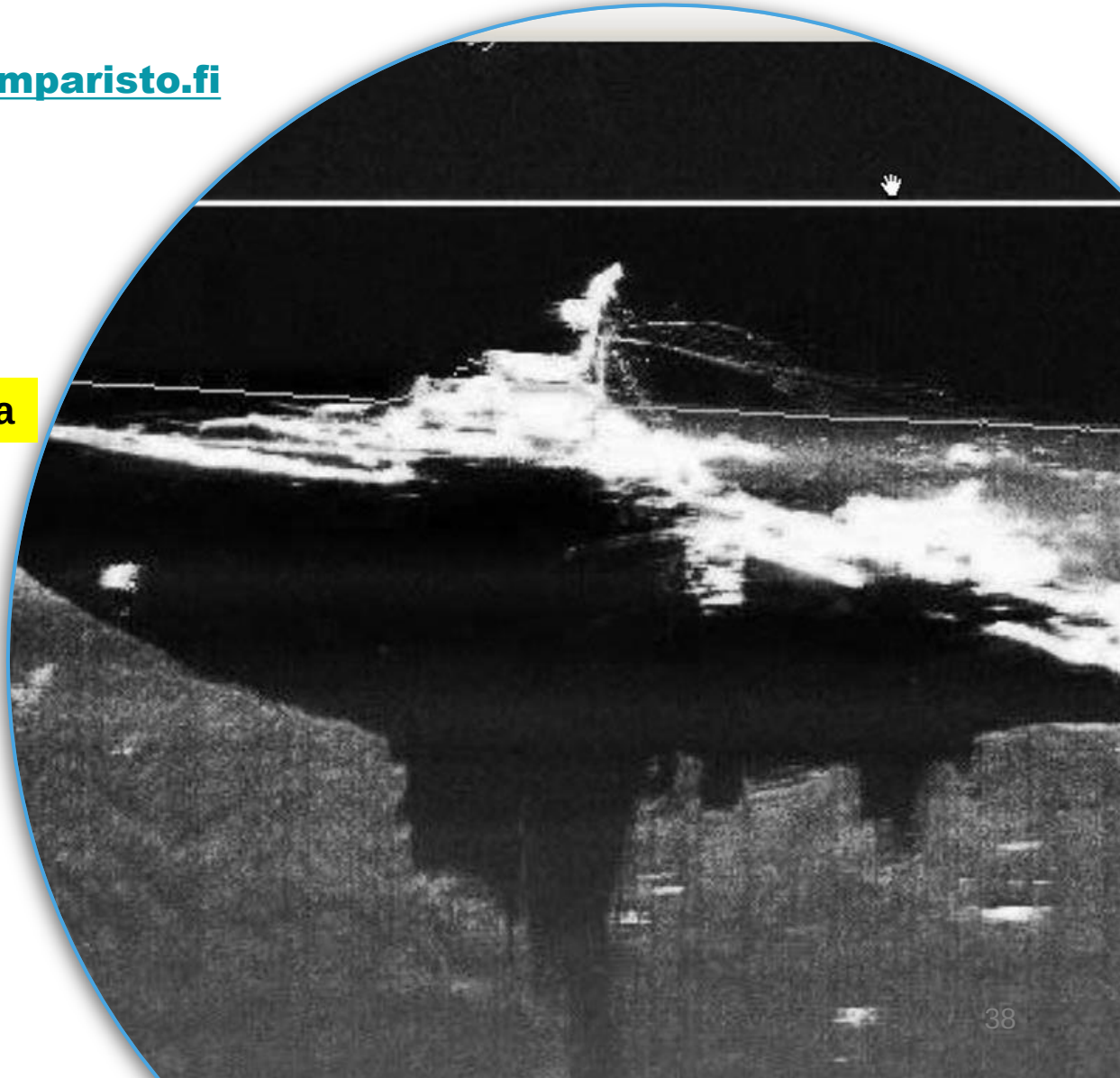
FRESHWATER CENTRE

BONUS
SCIENCE FOR A BETTER FUTURE OF THE BALTIC SEA REGION

More Information

jorma.rytkonen@ymparisto.fi

www.syke.fi/projects/swera



German Destroyer lying in the depths of Finnish coastal waters

SYKE